

CLAIMS

What is claimed is:

1. A method of operating a turbogenerator to provide a varying amount of power, the turbogenerator having an air compressor rotationally coupled to a turbine, the method comprising:

controlling turbogenerator speed to provide the required amount of power;

controlling air flow through the turbine inlet to prevent the compressor from stalling by venting a portion of the compressor output while the turbogenerator speed is between a predetermined lower surge value and a predetermined upper surge value; and

controlling the turbine exit temperature to a value derived as a function of turbogenerator speed and ambient conditions to maintain the required air flow.

2. The method of claim 1, wherein controlling the turbine exit temperature comprises:

controlling the turbine exit temperature in accordance with a first function of turbogenerator speed and ambient conditions while venting compressor output; and

controlling the turbine exit temperature in accordance with a second function of turbogenerator speed and ambient conditions while not venting compressor output.

3. The method of claim 2, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function;

comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

4. The method of claim 2, wherein venting a portion of the compressor output comprises:

commencing to vent the compressor output when the turbogenerator speed rises past the lower surge value; and

continuing to vent the compressor output until the turbogenerator speed falls below a predetermined lower safety value, the lower safety value being less than the lower surge value.

5. The method of claim 4, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function;
comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

6. The method of claim 2, wherein venting a portion of the compressor output comprises:

commencing to vent the compressor output when the turbogenerator speed falls below the upper surge value; and
continuing to vent the compressor output until the turbogenerator speed rises above a predetermined upper safety value, the upper safety value being higher than the upper surge value.

7. The method of claim 6, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function;

comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

8. The method of claim 2, wherein the turbogenerator includes a combustor having a plurality of fuel and air injectors and wherein controlling the turbine exit temperature comprises:

selectively providing fuel and air through one or more of the injectors to maintain a selected air-to-fuel ratio in the combustor.

9. The method of claim 8, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function;
comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

10. The method of claim 8, wherein venting a portion of the compressor output comprises:

commencing to vent the compressor output when the turbogenerator speed rises past the lower surge value; and

continuing to vent the compressor output until the turbogenerator speed falls below a predetermined lower safety value, the lower safety value being less than the lower surge value.

11. The method of claim 10, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function;
comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

12. The method of claim 8, wherein venting a portion of the compressor output comprises:

commencing to vent the compressor output when the turbogenerator speed falls below the upper surge value; and continuing to vent the compressor output until the turbogenerator speed rises above a predetermined upper safety value, the upper safety value being higher than the upper surge value.

13. The method of claim 12, wherein controlling the turbine exit temperature comprises:

selecting the first function or the second function; comparing the temperature value indicated by the selected function with a temperature value indicated by a desired turbine exit temperature function of turbogenerator speed and ambient conditions, the desired temperature function for indicating a maximum turbine exit temperature; and

controlling the turbine exit temperature to the lower of the value returned by the selected function and the value returned by the desired temperature function.

14. The method of claim 3, wherein the turbogenerator includes a combustor having a plurality of fuel and air injectors and wherein controlling the turbine exit temperature comprises:

selectively providing fuel and air through one or more of the injectors to maintain a selected air-to-fuel ratio in the combustor.

15. A turbogenerator system, comprising:

a turbine driven by hot gas;

a combustor for combusting fuel and compressed air to generate the hot gas;

an air compressor rotationally coupled to the turbine to provide the compressed air;

a bleed valve connected to the compressor discharge to vent a selectable portion of the compressed air while the turbogenerator speed is between a predetermined lower surge value and a predetermined upper surge value to prevent the compressor from stalling; and

a controller for controlling turbogenerator speed to provide a required amount of power, controlling the bleed valve to maintain a required airflow through the turbine inlet, and controlling the turbine exit temperature to a value derived as a function of turbogenerator speed and ambient conditions.

16. The system of claim 15, wherein the combustor comprises:

a plurality of fuel and air injectors for selectively providing fuel and air to maintain a selected air-to-fuel ratio in the combustor.

17. The system of claim 15, wherein the controller comprises:
a controller for controlling the turbine exit temperature
to a value derived in accordance with a first function of
turbogenerator speed and ambient conditions while the bleed
valve is venting compressed air and controlling the turbine exit
temperature in accordance with a second function of
turbogenerator speed and ambient conditions while the bleed
valve is not venting compressed air.

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18. The system of claim 17, wherein the controller comprises:
a controller for selecting the first function or the second
function and controlling the turbine exit temperature to the
lower of the value indicated by the selected function and the
value returned by a desired temperature function, the desired
temperature function for indicating a maximum turbine exit
temperature.

19. The system of claim 15, wherein the controller comprises:
a controller for controlling the bleed valve to vent
compressed air when the turbogenerator speed rises past the
lower surge value and to continue to vent compressed air until
the turbogenerator speed falls below a predetermined lower
safety value, the lower safety value being less than the lower
surge value.

20. The system of claim 15, wherein the controller comprises:
a controller for controlling the bleed valve to vent
compressed air when the turbogenerator speed falls below the
upper surge value and to continue to vent compressed air until
the turbogenerator speed rises above a predetermined upper
safety value, the upper safety value being higher than the upper
surge value.

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